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ATTORNEY'S DOCKET NUMBER 2495.14/PCT

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO (If known, see 37 C.F.R 1 5) 09/065,250 09/673908

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INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/US99/07389	23 April 1999 (23.04.99)	23 April 1998 (23.04.98)

TITLE OF INVENTION

METHODS AND APPARATUS FOR PROCESSING OPTICAL COMMUNICATION SIGNALS

APPLICANT(S) FOR DO/EO/US

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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. [X] This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. [ ] This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. [ ] This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the application time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. [X] A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. [X] A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. [ ] is transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] has been transmitted by the International Bureau.
   c. [X] is not required, as the application was filed in the United States Receiving Office (RO/US).
6. [ ] A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. [ ] Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. [ ] are transmitted herewith (required only if not transmitted by the International Bureau).
   b. [ ] have been transmitted by the International Bureau.
   c. [ ] have not been made; however, the time limit for making such amendments has NOT expired.
   d. [ ] have not been made and will not be made.
8. [ ] A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. [ ] An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. [ ] A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. [ ] An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. [ ] An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. [ ] A FIRST preliminary amendment.
    [ ] A SECOND or SUBSEQUENT preliminary amendment.
14. [ ] A substitute specification.
15. [ ] A change of power of attorney and/or address letter.
16. [ ] Other items or information:

APPLICATION NO (If known, see 37 C F R 1 5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
09/673908	PCT/US99/07389	2495.14/PCT

7. [X] The following fees are submitted:

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	CALCULATIONS		PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5):			
Search Report has been prepared by the EP or JPO **$860.00**			
International preliminary examination fee paid to USPTO (37 CFR 1.492(a)(1)) **$690.00**			
No international preliminary examination fee paid to USPTO (37 CFR 1.492 (a)(1)) but international search fee paid to USPTO (37 CFR 1.492(a)(2)) $710.00			
Neither international preliminary examination fee (37 CFR 1.492(a)(1)) nor international search fee (37 CFR 1.492(a)(2)) paid to USPTO **$1,000.00**			
International preliminary examination fee paid to USPTO (37 CFR 1.492 (a)(4)) and all claims satisfied provisions of PCT Article 33(1)-(4) **$100.00**			
ENTER APPROPRIATE BASIC FEE AMOUNT =	$	860	00
Surcharge of **$130.00** for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$		

Claims	Number Filed	Number Extra	Rate			
Total Claims	38-20 =	18	X $18.00	$	324	00
Independent Claims	6- 3 =	3	X $80.00	$	240	00
Multiple dependent claim(s) (if applicable)			+ $270.00	$	0	

TOTAL OF ABOVE CALCULATIONS =	$	1424	00
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).	$		
SUBTOTAL =	$	1424	00
Processing fee of **$130.00** for furnishing the English translation later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(f)).	$		
TOTAL NATIONAL FEE =	$		
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +	$		
TOTAL FEES ENCLOSED =	$	1424	00
	Amount to be:		
	refunded	$	
	charged	$	

a. [X] A check in the amount of $1424.00 to cover the above fees is enclosed.

b. [ ] Please charge my Deposit Account No. ______ in the amount of $________ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. [X] The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 06-2506. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

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Form #119

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METHODS AND APPARATUS FOR SELECTIVE ATTENUATION IN AN OPTICAL COMMUNICATION USING ELECTROCHROMIC MATERIAL

Background

The present invention relates to optical communication networks. More particularly, the present invention relates to methods and apparatus for processing optical communication signals, including selective attenuation of an optical communication signal using a body of electrochromic material.

Over the past several years, optical links have increasingly become an important and fundamental part of modern communications networks. Optical communication networks typically comprise sources of electromagnetic radiation (or light), optical waveguides, optical couplers and other components such as, for example, switches, multiplexers, modulators and attenuators, which together operate to generate, carry and appropriately route optical communication signals along optical links of the communication network. Operating wavelengths for such communication networks may be on the order of approximately 0.85 microns for a local area network (LAN), for example, or may be longer for applications such as telecommunications. Wavelengths used in communication networks for long distance telecommunication transmission, for example, may be on the order of approximately 1.3 to 1.6 microns.

Such networks may carry optical communication signals of a particular wavelength, or alternatively may carry optical communication signals that comprise a multiplicity of discrete wavelengths or bands of wavelengths. Networks that use one wavelength may require that the optical power at that wavelength be adjusted or reset along the route, either attenuated or amplified, in order to deliver to the ultimate receiver a power level lying within the receiver's

dynamic range. Similarly, networks that use multiple wavelengths of light, wavelength division networks, typically require that the relative power levels in at least certain ones of the various bands of wavelengths be adjusted or reset at frequent intervals along a given optical link to ensure that the network is operating with a power versus wavelength profile that is suitably flat. A suitably flat profile helps to ensure that each receiver sees a power level lying within its dynamic range. Periodic adjustment of this sort is particularly important in optical networks that employ optical amplifiers, as such amplifiers often possess a gain versus wavelength profile that does not have the desired level of flatness.

Prior methods and systems for attenuating the optical signal to compensate for such non-ideal characteristics typically are relatively costly, cumbersome and prone to failure. An example prior art system employs a transparent film having gray scale thereon spanning in graduated fashion a range of densities from one end of the film to the other end. The film is manipulated relative to the light path using a mechanical stepper motor such that the film intersects the light path of interest at a particular gray scale point along the length of the film. The opacity of the film absorbs certain electromagnetic energy from a signal traveling along the light path, thus resulting in signal attenuation. The ability to selectively manipulate the film using a stepper motor, and in turn the degree of gray scale intersecting the light path, provides control over the degree of signal attenuation. The use of a stepper motor and film device in this manner, however, can be relatively cumbersome and costly. The system, with its moving parts, is also prone to mechanical failure.

Electrochromic devices previously have been proposed for use in optical communications systems. U.S. Patent 4,245,883 issued to Johnson et al., for example, describes particular components which are electrically activated for use as switches, modulators,

attenuators, and mode selectors in networks of waveguides in optical communications systems. The attenuator described by Johnson et al., however, involves relatively expensive waveguide technology and attenuates light in a rather indirect manner. The attenuator disclosed by Johnson et al. attenuates radiation propagating in a waveguide through the use of a cladding layer of electrochromic material disposed parallel to the waveguide to absorb a certain fraction of energy. Such arrangements are less practical for many optical communications systems, for reasons of cost and complexity.

SUMMARY OF THE INVENTION

The present invention relates to new methods and apparatus for processing optical communication signals in a communications network, which include the use of an electrochromic medium to provide optical signal attenuation. An optical signal corresponding to voice and/or data information and traveling in a communications network is selectively attenuated through the use of a body of electrochromic material that is disposed to intersect the propagation path. The amount by which optical network traffic is attenuated can be varied through variable application of an electric field in such a way as to affect the body of electrochromic material. The applied electric field operates to affect a change in the color or opacity of the electrochromic material, and thus the degree of attenuation that is provided by the electrochromic medium. The optical signal passes through the electrochromic medium, where it is attenuated, and is thereafter communicated to the communication network for further processing.

The present invention provides for selective attenuation of optical communication signals in a flexible, efficient, reliable, and cost-effective manner. The present invention also

may, in the appropriate applications, operate to relax requirements imposed upon optical amplifiers relative to the flatness of the amplifier's gain versus wavelength profile. These and other objects of the present invention will be apparent to those of skill in the art from the description of the preferred embodiment that follows.

BRIEF DESCRIPTION OF THE DRAWING

Preferred embodiments of the present invention are described herein with reference to the drawing wherein:

FIGURE 1 illustrates schematically, in side view, an electro-optic attenuation device in accordance with one example embodiment of the present invention;

FIGURE 2 illustrates an end and partial cross-sectional view of the electro-optic attenuation device embodiment shown in Figure 1;

FIGURE 3 illustrates schematically a first example communication network link of the present invention that provides selective attenuation of an optical signal traveling along the link;

FIGURE 4 shows schematically a first example embodiment of an optical transport system of the present invention that provides selective attenuation of constituent optical signals of a wavelength division multiplexed signal;

FIGURE 5 shows schematically a second example embodiment of an optical transport system of the present invention that provides selective attenuation of constituent optical signals of a wavelength division multiplexed signal;

FIGURE 6 shows schematically a third example embodiment of an optical transport system of the present invention that provides selective attenuation of constituent optical signals of a wavelength division multiplexed signal; and

FIGURE 7 illustrates schematically a second example communication network link of the present invention that provides selective attenuation of constituent optical signals of a wavelength division multiplexed signal traveling on the link.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Generally, the electrochromic effect involves the ability to adjust the relative color of a material through chemical changes in an electrochromic material, these changes being caused by introducing into the body of the material a number of ions supplied by the adjacent conductive layer, the density of ions so supplied being controlled by the intensity of an applied electric field. For instance, a layer of electrochromic material and a compatible ion conducting layer may be together sandwiched between two layers of transparent conductors. Electrochromic materials may include a suitable inorganic material, such as WO_3 for example, or a suitable organic material. The ion conducting layer may be realized using, for example, an electrolyte or an ion rich solid. The two conductors which effectively sandwich the layer of electrochromic material and the ion conducting layer may be, for example, layers of indium tin oxide (ITO). A relatively small potential difference (typically on the order of a few volts) applied across the conductors, for example, induces an electric field that causes the electrochromic material to electrochemically react with the ion conducting layer. This reaction causes a change in the amount of light that is absorbed by the material, and in turn a change in the relative color or opaqueness of the electrochromic layer. By appropriately varying the applied voltage potential, the electrochromic material may be controllable between at least a first state that passes some or all of incident light, and a second state that results in a complete or at least partial reduction of the level of incident light that passes through the layer relative to the first state.

Preferred embodiments of the present invention are shown in the Figures. Figures 1 and

2, for example, provide schematic illustrations of an electro-optic attenuation device **10** constructed in accordance with one example embodiment of the present invention. In particular, a substrate **11**, constructed from transparent silica or other suitable material, supports an electrochromic sandwich **12** that comprises an electrochromic region **14**, an adjacent conductive region **16**, and transparent electrodes **18** and **20**. Substrate **11**, region **14**, region **16**, electrode **18** and electrode **20** of device **10** preferably are adjacent, substantially parallel, planar layers. Graded index lenses **22** and **24** are disposed on either side of the sandwich **12** as shown in Figure 1. Graded index lenses **22** and **24** each communicate optically with optical fibers **26** and **28**, respectively. Optical fibers **26** and **28** each comprise a length of an optical core **30** and **31**, respectively, that is surrounded by a cladding material **32** and **33**, respectively. The cladding material **32** and **33** is shown partially removed in Figure 1 to more clearly illustrate the inner cores **30** and **31**. Electrical leads **34** and **36** extend from electrodes **18** and **20**, respectively, and preferably connect to a variable voltage source **37** that is adapted to apply various voltage potentials across electrodes **18** and **20** as desired. A casing **38** is used in this example embodiment to substantially encapsulate the sandwich **12** and graded index lenses **22** and **24**, although a portion of the casing **38** is shown removed in Figure 1 to clearly illustrate interior components of the device **10**. This casing **38**, which may be constructed from a polymer or other suitable material, serves as a protective exterior for at least a portion of the electro-optic attenuation device **10**. Casing **38** has apertures **40**, **42**, **44**, and **46** through which pass fiber **26**, fiber **28**, lead **34** and lead **36**, respectively.

Region **14** of sandwich **12** is a layer comprising a suitable inorganic electrochromic material such as WO_3 for example, or a suitable organic electrochromic material. Region **16** is an ion conducting layer such as, for example, an electrolyte or an ion rich solid. Electrodes **18**

and **20** each comprise a transparent conductive coating of suitable transparent electrode material. Indium tin oxide (ITO), zinc oxide and tin oxide are example transparent electrode materials. Leads **34** and **36** communicate electrically with electrodes **18** and **20**, and are used to establish a desired potential difference across, and resultant electric field between, the electrodes **18** and **20**. The thickness of the sandwich **12** and range of voltages applied to the electrodes **18** and **20**, two factors which can affect the range and degree of transmission and attenuation provided by device **10**, are preferably selected so that the device **10** satisfies the operating requirements of the particular application. Further, particular applications of the present invention may warrant the selection of alternative materials and/or material relationships within device **10** that are apparent to persons of ordinary skill in the art.

Referring now to Figures 1 and 2, the present invention is preferably used to process an optical signal in an optical link of a communications network, such as a local area network or telecommunications network for example. In Figure 1, the combination of lens **22** and lens **24**, as well as associated fibers **26** and **28**, operate to define and establish a propagation path **48** along which a digital or analog optical communication signal travels. An optical communication signal travels along fiber **26** towards lens **22** along path **48**. Lens **22** collimates the light of the optical signal traveling in fiber **26**. The collimated light is then delivered to the planar electrochromic sandwich **12** and, more particularly, to an incident planar surface **13** of the region **14** through substrate **11** and electrode **18** along path **48**. Path **48** preferably is substantially perpendicular to the planar sandwich **12** and the incident planar surface **13** of the region **14**. Electrochromic sandwich **12** is disposed along and intersects the path **48** such that sandwich **12** effectively bisects the path **48** into a first portion **48a** and a second portion **48b**. The optical signal thus traveling along path **48** is passed through the sandwich **12**, including the

region **14**, where it may be attenuated by absorption. Selective application of an appropriate voltage potential V across, and resultant electric field between, electrodes **18** and **20** is used to effect the desired color or opacity (i.e., electrochromic or attenuating effect) in sandwich **12** and, in particular, region **14**. In this regard it is preferred that the region **14** be switchable between at least two color states to provide for variable attenuation. An attenuated optical signal is thereafter received in lens **24** following passage through electrode **20**, and communicated along path **48** into fiber **28** for further processing in the communication link and/or communication network. Such further processing may include, for example, downstream reception and detection of the optical signal to facilitate the successful transfer of voice and/or data information to its intended destination.

Figure 3 depicts an example communication network link **60** comprising a transmitter **62**, a receiver **64** and an intermediately disposed electro-optic attenuation device **10** that, on a first side, communicates through optical medium **66** with the transmitter **62** and, on a second side, communicates through optical medium **68** with the receiver **64**. Selective attenuation of an optical signal traveling along the link **60** is provided by application of the appropriate voltage potential across electrodes **18** and **20** of device **10**, as described above. Link **60** may form a part of a larger communication network such as, for example, a local area network or local and/or long distance telecommunication network.

Figure 4 is a schematic illustration of an example embodiment of an optical transport system **80** of the present invention that may be used to provide selective attenuation of constituent optical signals in a wavelength division multiplexed communications link. The system **80** comprises an optical line **82** through which a wavelength division multiplexed optical communication signal is received. Optical line **82** communicates the received signal to

demultiplexer **84**. Constituent optical signals are each delivered by demultiplexer **84** to respective optical lines **1**, **2**, ... **L**. Each of optical lines **1**, **2**, ... **L** communicates the respective constituent signal to a device **10** which, in turn, is used to provide a level of attenuation that is particularly suited for the constituent signal, as described above for example. The constituent signal is thereafter provided to the corresponding line of optical lines **1'**, **2'**, ... **L'**. In this manner each of the constituent signals of a wavelength division multiplexed optical communication signal may be independently adjusted or reset within the optical transport system **80** to the extent necessary to ensure a suitably flat power versus wavelength profile.

Figure 5 is a schematic illustration of another example embodiment of an optical transport system **90** of the present invention that also may be used to provide selective attenuation of constituent optical signals in a wavelength division multiplexed communications link. The system **90** comprises an array of optical lines **1**, **2**, ... **M** through which constituent optical communication signals are respectively received. Each of the optical lines **1**, **2**, ... **M** communicates the received constituent signal to a device **10** which is used to provide a level of attenuation that is particularly suited for the signal. The signal is thereafter delivered through the corresponding line of optical lines **1'**, **2'**, **... M'** to multiplexer 92. Multiplexer **92**, in turn, multiplexes the various signals to form a wavelength division multiplexed optical signal for communication on optical line **94**. Again, each of the constituent signals of the wavelength division multiplexed optical communication signal may be independently adjusted or reset within the optical transport system **90** to the extent necessary to ensure a suitably flat power versus wavelength profile.

Figure 6 is a schematic illustration of yet another embodiment of an optical transport system **100** of the present invention that may be used to provide selective attenuation of

constituent optical signals in a wavelength division multiplexed communications link. The system **100** comprises an optical line **102** through which a wavelength division multiplexed optical communication signal is received. Optical line **102** communicates the received signal to demultiplexer **104**. Constituent optical signals are each delivered by demultiplexer **104** to respective optical lines **1, 2, … N**. Each of optical lines **1, 2, … N** communicates the respective constituent signal to a device **10** which is used to provide a level of attenuation that is particularly suited for the constituent signal. The constituent signal is thereafter provided to multiplexer **106** through the corresponding line of optical lines **1', 2', … N'**. Multiplexer **106**, in turn, multiplexes the various signals to form a wavelength division multiplexed optical signal for communication on optical line **108**. Each of the constituent signals of the wavelength division multiplexed optical communication signal may be independently adjusted or reset within the optical transport system **100** to the extent necessary to ensure a suitably flat power versus wavelength profile.

Figure 7 depicts an example wavelength division multiplexed optical communication network link **110** comprising a transmitter **112**, a receiver **114**, and an intermediately disposed optical transport system **116** that, on a first side, communicates through optical medium **118** with the transmitter **112** and, on a second side, communicates through optical medium **120** with the receiver **114**. In one embodiment, optical transport system **116** might be, for example, optical transport system **80** from Figure 4, wherein system **80** might further communicate respective constituent signals to receiver **114** and other receivers (not shown) in parallel. In another embodiment, optical transport system **116** might be, for example, optical transport system **90** from Figure 5, wherein system **90** might receive respective constituent signals from transmitter **114** and other transmitters (not shown) in parallel. Further, in yet another

embodiment, optical transport system **116** might be, for example, optical transport system **100** from Figure 6, wherein both lines **118** and **120** carry a wavelength division multiplexed optical communication signal. In this way the optical transport system **116** may provide selective attenuation of constituent optical signals traveling along the link **110**. Link **110** may form a part of a larger communication network such as, for example, a local area network or local and/or long distance telecommunication network.

Although certain embodiments of the invention have been described and illustrated herein, it will be readily apparent to those of ordinary skill in the art that a number of modifications and substitutions can be made to the preferred example methods and apparatus disclosed and described herein without departing from the true spirit and scope of the invention.

I claim:

1. A method for processing an optical signal in a communications link, comprising the steps of:

establishing a propagation path along which an optical communication signal travels;

providing a body of electrochromic material that intersects the path;

passing through the body of electrochromic material an optical communication signal traveling along the path to attenuate the signal; and

communicating the attenuated optical communication signal for further processing in the communication link.

2. The method for processing an optical signal in a communications link as set forth in claim 1, wherein the signal traveling along the path is a constituent optical signal that is demultiplexed from a wavelength division multiplexed (WDM) optical communication signal.

3. The method for processing an optical signal in a communications link as set forth in claim 1, further comprising the step of multiplexing the attenuated signal into a wavelength division multiplexed (WDM) optical communication signal.

4. The method for processing an optical signal in a communications link as set forth in claim 1, further comprising the steps of:

passing the optical communication signal through a first transparent electrode

disposed proximate the body prior to passing the signal through the body; and

passing the optical communication signal through a second transparent electrode disposed proximate the body after passing the signal through the body.

5. The method for processing an optical signal in a communications link as set forth in claim 1, further comprising the steps of:

passing the optical communication signal through a first graded index lens disposed proximate the body prior to passing the signal through the body; and

passing the optical communication signal through a second graded index lens disposed proximate the body after passing the signal through the body.

6. The method for processing an optical signal in a communications link as set forth in claim 1, wherein the optical communication signal comprises a telecommunication signal.

7. The method for processing an optical signal in a communications link as set forth in claim 6, wherein the body is switchable between at least two color states.

8. The method for processing an optical signal in a communications link as set forth in claim 1, wherein the optical communication signal comprises a local area network (LAN) signal.

9. A method for processing an optical signal in a communications link, comprising

the steps of:

providing a body of electrochromic material, the body being switchable between at least two color states;

applying a voltage potential proximate the body to effect one of the at least two color states of the body;

delivering an optical communication signal to an incident planar surface of the body along a propagation path that is substantially perpendicular to the planar surface;

passing the signal through the body to attenuate the signal; and

communicating the attenuated optical communication signal for further processing in the communication link.

10. The method for processing an optical signal in a communications link as set forth in claim 9, wherein the signal is a constituent optical signal that is demultiplexed from a wavelength division multiplexed (WDM) optical communication signal.

11. The method for processing an optical signal in a communications link as set forth in claim 9, further comprising the step of multiplexing the attenuated signal into a wavelength division multiplexed (WDM) optical communication signal.

12. The method for processing an optical signal in a communications link as set forth in claim 9, further comprising the step of passing the optical communication signal through a first transparent electrode disposed adjacent the body prior to passing the signal through the body.

13. The method for processing an optical signal in a communications link as set forth in claim 12, further comprising the step of passing the optical communication signal through a second transparent electrode disposed adjacent the body after passing the signal through the body.

14. The method for processing an optical signal in a communications link as set forth in claim 9, further comprising the step of passing the optical communication signal through a first graded index lens disposed adjacent the body prior to passing the signal through the body.

15. The method for processing an optical signal in a communications link as set forth in claim 14, further comprising the step of passing the optical communication signal through a second graded index lens disposed adjacent the body after passing the signal through the body.

16. The method for processing an optical signal in a communications link as set forth in claim 9, further comprising the steps of:

passing the optical communication signal through both a first graded index lens and a first transparent electrode prior to passing the signal through the body, the first lens and first electrode both being disposed proximate the body; and

passing the optical communication signal through both a second transparent electrode and a second graded index lens after passing the signal through the body, the

second lens and second electrode both being disposed proximate the body,

wherein the voltage potential is applied across the first and second electrodes.

17. The method for processing an optical signal in a communications link as set forth in claim 9, wherein the optical communication signal comprises a telecommunication signal.

18. The method for processing an optical signal in a communications link as set forth in claim 9, wherein the optical communication signal comprises a local area network (LAN) signal.

19. A method for processing an optical signal in a communications link, comprising the steps of:

demultiplexing a first wavelength division multiplexed (WDM) optical communication signal into its constituent optical signals;

providing a body of electrochromic material, the body being switchable between at least two color states;

applying a voltage potential proximate the body to effect one of the at least two color states of the body;

delivering a demultiplexed constituent optical communication signal to an incident surface of the body;

passing the demultiplexed constituent optical signal through the body to attenuate the signal;

multiplexing the attenuated constituent optical signal into a second WDM optical communication signal; and

communicating the second WDM signal for further processing in the communication link.

20. The method for processing an optical signal in a communications link as set forth in claim 19, wherein the incident surface of the body is a planar surface and wherein the demultiplexed constituent optical signal is delivered to the incident planar surface along a propagation path that is substantially perpendicular to the incident planar surface.

21. The method for processing an optical signal in a communications link as set forth in claim 19, wherein the body of electrochromic material is disposed intermediate two transparent electrodes across which the voltage potential is applied.

22. The method for processing an optical signal in a communications link as set forth in claim 19, wherein the body of electrochromic material is disposed intermediate two graded index lenses.

23. The method for processing an optical signal in a communications link as set forth in claim 19, further comprising the step of passing the demultiplexed constituent optical signal through a first graded index lens disposed adjacent the body prior to passing the signal through the body.

24. The method for processing an optical signal in a communications link as set forth in claim 23, further comprising the step of passing the demultiplexed constituent optical signal through a second graded index lens disposed adjacent the body after passing the signal through the body.

25. The method for processing an optical signal in a communications link as set forth in claim 19, further comprising the steps of:

passing the demultiplexed constituent optical signal through both a first graded index lens and a first transparent electrode prior to passing the signal through the body, the first lens and first electrode both being disposed proximate the body; and

passing the constituent optical signal through both a second transparent electrode and a second graded index lens after passing the signal through the body, the second lens and second electrode both being disposed proximate the body,

wherein the body of electrochromic material is disposed intermediate the first and second electrodes and wherein the voltage potential is applied across the first and second electrodes.

26. The method for processing an optical signal in a communications link as set forth in claim 19, wherein the first and second WDM signals comprise telecommunication signals.

27. The method for processing an optical signal in a communications link as set

forth in claim 19, wherein the first and second WDM signals comprise local area network (LAN) signals.

28. An attenuating device for use in processing an optical signal in a communications link, comprising:

first and second graded index lenses disposed to establish a propagation path for an optical communication signal; and

a body of electrochromic material disposed intermediate the first and second graded index lenses to intersect the propagation path, the body being switchable between at least two color states that each permit at least attenuated passage through the body of an optical communication signal traveling along the propagation path.

29. The attenuating device set forth in claim 28, further comprising a first transparent electrode disposed intermediate the first graded index lens and the body of electrochromic material, and further comprising a second transparent electrode disposed intermediate the body of electrochromic material and the second graded index lens.

30. The attenuating device set forth in claim 28, further comprising a first fiber optic cable that communicates optically with the first graded index lens, and further comprising a second fiber optic cable that communicates optically with the second graded index lens.

31. The attenuating device set forth in claim 28, wherein the body of electrochromic

material has an incident planar surface that is substantially perpendicular to the propagation path.

32. The attenuating device set forth in claim 28, wherein the first graded index lens is connected to receive a constituent optical signal that is demultiplexed from a wavelength division multiplexed (WDM) optical communication signal.

33. The attenuating device set forth in claim 28, wherein the second graded index lens is connected to communicate an optical signal attenuated by passage through the body to a multiplexer for multiplexing the attenuated signal into a wavelength division multiplexed (WDM) optical communication signal.

34. The attenuating device set forth in claim 28, wherein the first graded index lens is connected to receive a constituent optical signal that is demultiplexed from a first wavelength division multiplexed (WDM) optical communication signal, and wherein the second graded index lens is connected to communicate the attenuated constituent optical signal to a multiplexer for multiplexing the attenuated signal into a second wavelength division multiplexed (WDM) optical communication signal.

35. The attenuating device set forth in claim 28, wherein the device is connected to process an optical telecommunication signal.

36. The attenuating device set forth in claim 28, wherein the device is connected to

process an optical local area network (LAN) signal.

37. A device for attenuating an optical telecommunications signal, comprising:

a first waveguide connected to receive an optical signal that represents a digital telecommunication signal;

a second waveguide disposed to cooperate with the first waveguide to establish a propagation path through the first and second waveguides for the received optical signal;

a variable source; and

an electrochromic device electrically connected to the variable source and disposed intermediate the first and second waveguides to intersect the propagation path such that an incident planar surface of the electrochromic device is substantially perpendicular to the propagation path, wherein an electrochromic medium of the electrochromic device intersects the propagation path and is responsive to a voltage potential established at the device by the variable source to attenuate the received optical signal as the signal passes through the electrochromic medium.

38. A method for processing an optical signal in a communications link, comprising the steps of:

establishing a propagation path along which the optical signal travels;

providing an electrochromic region to intersect the propagation path; and

attenuating the optical signal by passing the signal through the electrochromic region.

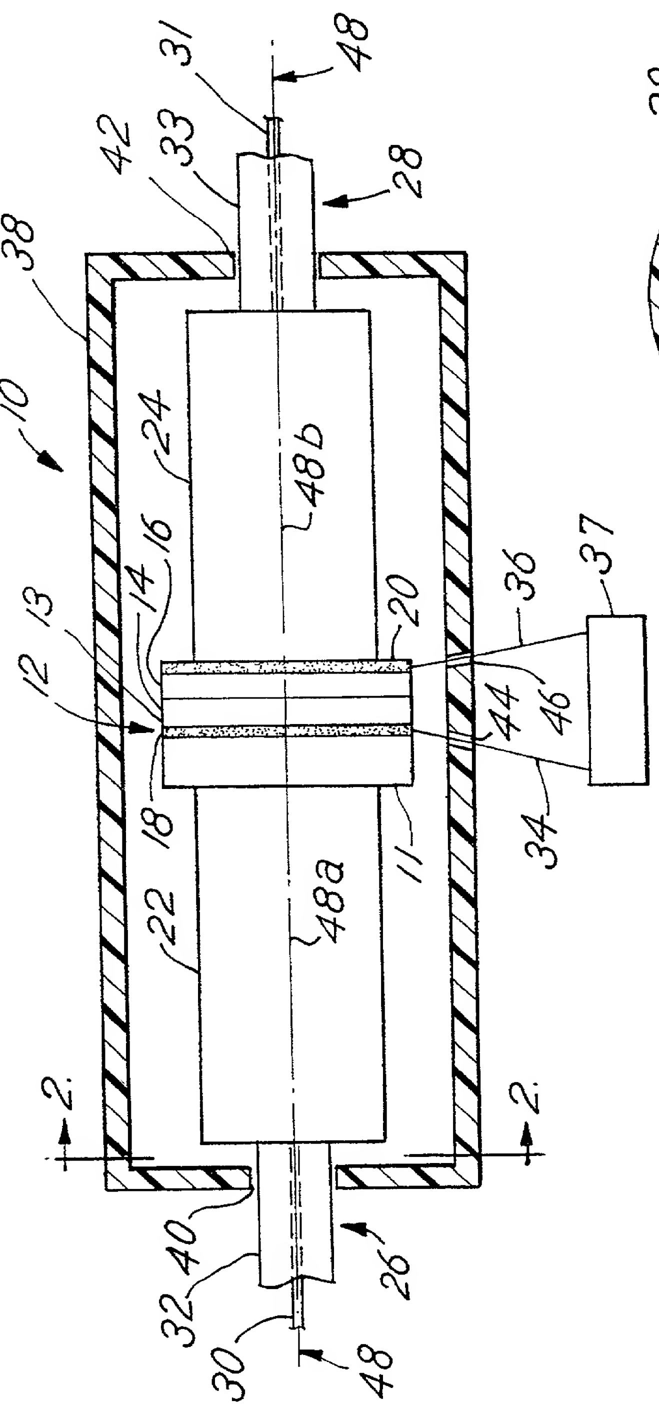
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FIG. 1

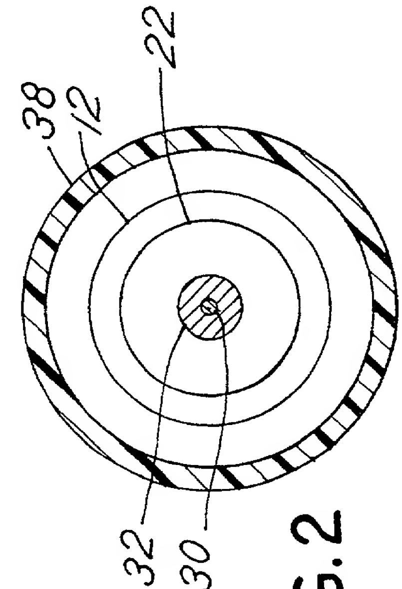
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FIG. 2

FIG. 3

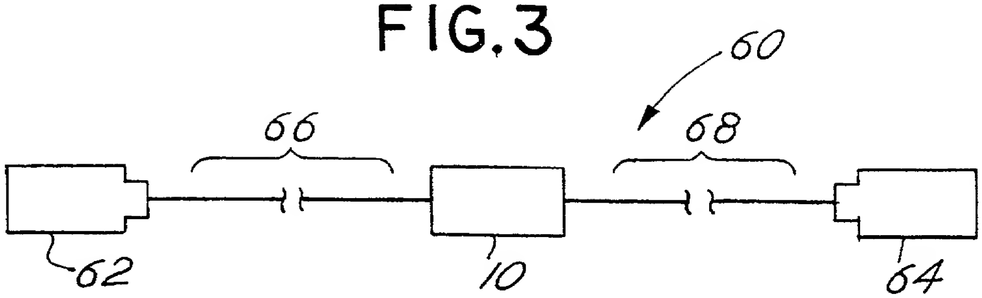


FIG. 4

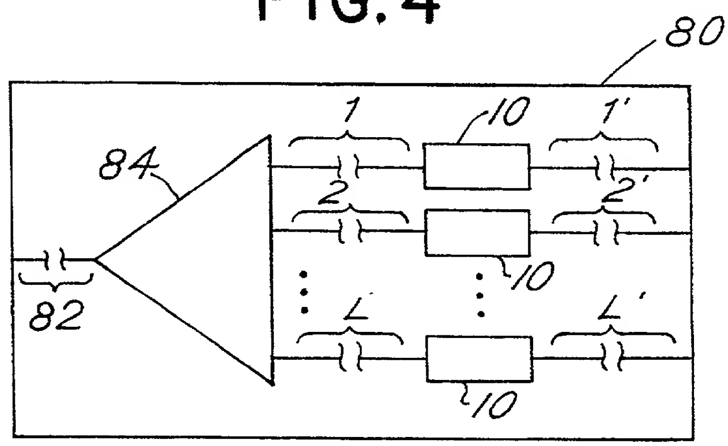


FIG. 5

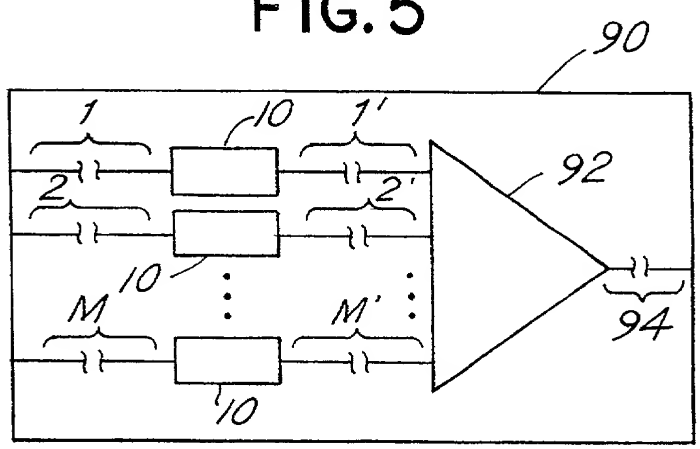


FIG. 6

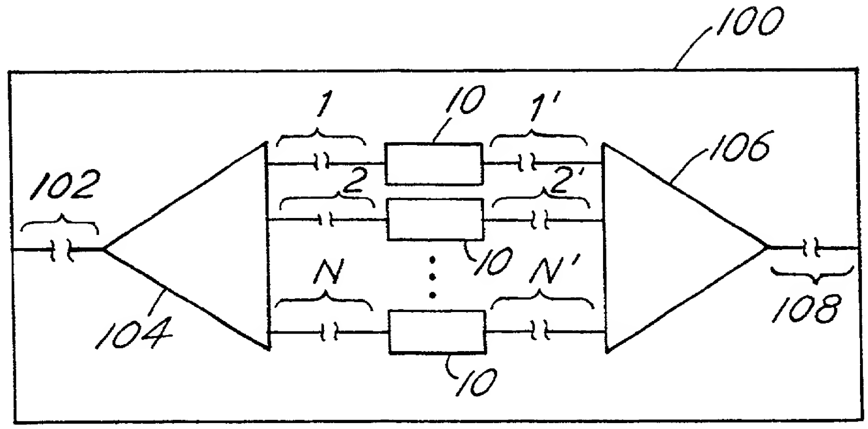
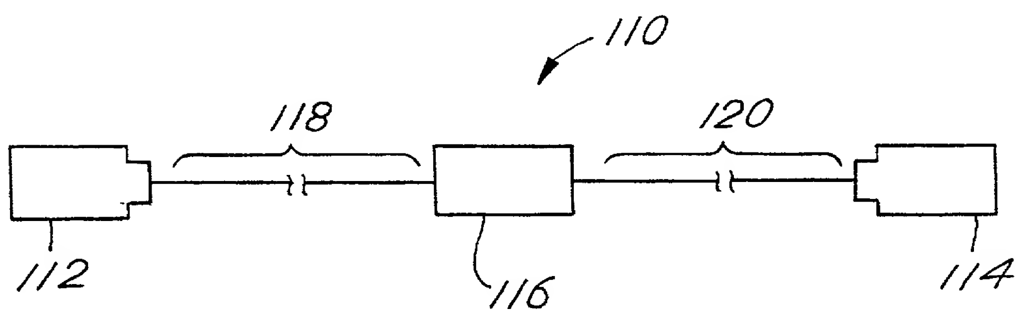


FIG. 7



COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT COOPERATION TREATY APPLICATION FOR ENTERING US STAGE (US APPLN. NO. 09/673,908)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled METHODS AND APPARATUS FOR SELECTIVE ATTENUATION IN AN OPTICAL COMMUNICATION USING ELECTROCHOMIC MATERIAL ________,

the specification of which was filed as PCT International Application No. PCT/US99/07389 on April 23, 1999 and was amended under PCT Article 19 on ________ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	Priority Claimed (Yes/No)
US	09/065,250	23 April 1998	Yes

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature ________
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